Compositional Analysis of Pottery from Kota Cina, North Sumatra: Implications for Regional Trade during the Twelfth to Fourteenth Centuries A.D.

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FINE PASTE WARE is an earthenware found at sites distributed over a broad area of Southeast Asia, from the Philippines to east Java, and from north Sumatra to Viet Nam. A Chinese archaeologist has reportedly compared this ware to sherds found at the Dung Zishan kilns, Ziyao, China (Lim 1987:24). Its color, texture, and form are quite distinct from the utilitarian pottery characteristic of these sites. It is made from a relatively pure clay, which can be obtained from only a few sources in the region. It is hoped that analysis of the mineral composition of this pottery will indicate the source or sources of this ware and allow us to reconstruct the pattern of trade in this locally produced but regionally distributed commodity.

Such information would provide some of the first concrete archaeological evidence for regional trade in Southeast Asia to complement the data on long distance trade contained in Chinese and Arabic sources. If more such studies are conducted, it may be possible to reassess the significance of long distance trade in the ancient economies and societies of Southeast Asia.

REVIEW OF THE PREVIOUS ANALYSIS

We selected a broad range of samples for the first exploration of this problem. Fourteen sherds came from an excavation of a fourteenth-century context at Fort Canning, Singapore (Fig. 1). The Fort Canning sherds represented five categories: (1) two types of Chinese stoneware, one buff and fine-bodied, the other dark and coarse-bodied; (2) light-colored, sand-tempered, low-fired vessels believed to have been made in Singapore; (3) red ware with very coarse inclusions; (4) pieces of roof tiles, again in all probability made locally in Singapore; and (5) one sherd of what we have called Fine Paste ware, suspected of being an import.

The mineral content of the samples was analyzed with the energy-dispersive x-ray fluorescence technique at the National University of Singapore's Physics Department. Results were plotted on a triangular graph (compare Snow, Payne, and

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D'Auria [1985] for a similar approach to the analysis of earthenware from northern Luzon). After experimenting with various trace elements, we found that relative abundances of rubidium, zirconium, and strontium permitted the best discrimination between groups. The addition of more elements to the plot did not alter the distribution significantly.

The sherds formed several distinct groups. The two types of Chinese stonewares lay very far apart on the graph. The earthenwares did not overlap with either group; nor did they form a very tight group even within one type of ware. It would seem that Singapore clay has a high degree of mineralogical variability. Put another way, supplies of clay found in Singapore are not very homogeneous, and they are not very suitable for making high-quality ceramics.

Six sherds from surface finds at two sites in south Thailand were included in the sample. The sites, Kok Moh and Satingphra (Fig. 1), lie close together geographically, and the sherds from the two form a tight group, suggesting that they have a high degree of homogeneity in their mineral composition. The clays from this area are relatively pure and well suited to pottery making. One of the Singapore sherds seems likely to belong to this group. This sherd, assigned to the Fine Paste ware, is the one that was suspected of being an import at Fort Canning.

Singapore lay at the boundary of two spheres of influence in the fourteenth century: those of Majapahit in east Java and of central Thailand (which had its capital at Ayudhya after A.D. 1350). Two sherds of fourteenth- or fifteenth-century porcelain from Sawankhalok were found at Fort Canning, but in a disturbed context. The Siamese attacked Singapore around A.D. 1330, and after Majapahit's decline in the 1380s they became Singapore's suzerain for about 100 years. The Satingphra region at that time was still under the control of local Malay rulers, although they too had to pay tribute to the Siamese. Thus it is not at all surprising to discover that Singapore was importing pottery from south Thailand.

The other 20 sherds in the sample were obtained from 4 sites in Java (Fig. 1). Four sherds, from Gatak, were found in an excavation near Prambanan, in a context datable to about the ninth century A.D. Seven sherds came from surface finds at two sites on the Dieng plateau, where early occupation dates to the eighth and ninth centuries. The Dieng sherds fell into two distinct groups. One group was tempered with coarse sand, was thick, and exhibited unburnished surfaces. The other group was thin-bodied and finely made (perhaps on a wheel), lacked temper, and was dark red. This group overlapped with the Gatak material. Even more significantly, it also overlapped with sherds from a surface collection found at the site of Trowulan, east Java.

The Trowulan and Dieng sherds look very similar, whereas the Gatak sherds appear visually quite different, being pale buff with a gray core. Nevertheless it appears that fine pottery, probably for ceremonial purposes, was already being made in east Java in the eighth or ninth century A.D. and continued to be made (or production resumed) at the same site in the fourteenth century.

The first research project allowed us to draw the conclusion that finely made ceramics, probably used for ceremonial purposes, were being exchanged over large areas of Southeast Asia between the ninth and fourteenth centuries. We also suggested that these wares were not made at a single center of production; rather, there were at least two centers, one in south Thailand, the other in east Java. There may

Fig. 1. Sites in Southeast Asia dating to A.D. 900–1300.

have been other production locales as well; visually similar material has been found in Viet Nam and the Philippines.

CURRENT ANALYSIS OF FINE PASTE WARE

A large quantity of similar Fine Paste ware has been discovered at the site of Kota Cina, northeast Sumatra. This was the location of an important trading port from the late eleventh to the late thirteenth century, but it is not mentioned in any known documents. Several excavations have been conducted at the site by the Indonesian National Research Centre for Archaeology, and a large amount of data has been collected (Hasan M. Ambary 1977; Sonny Chr. Wibisono 1981).

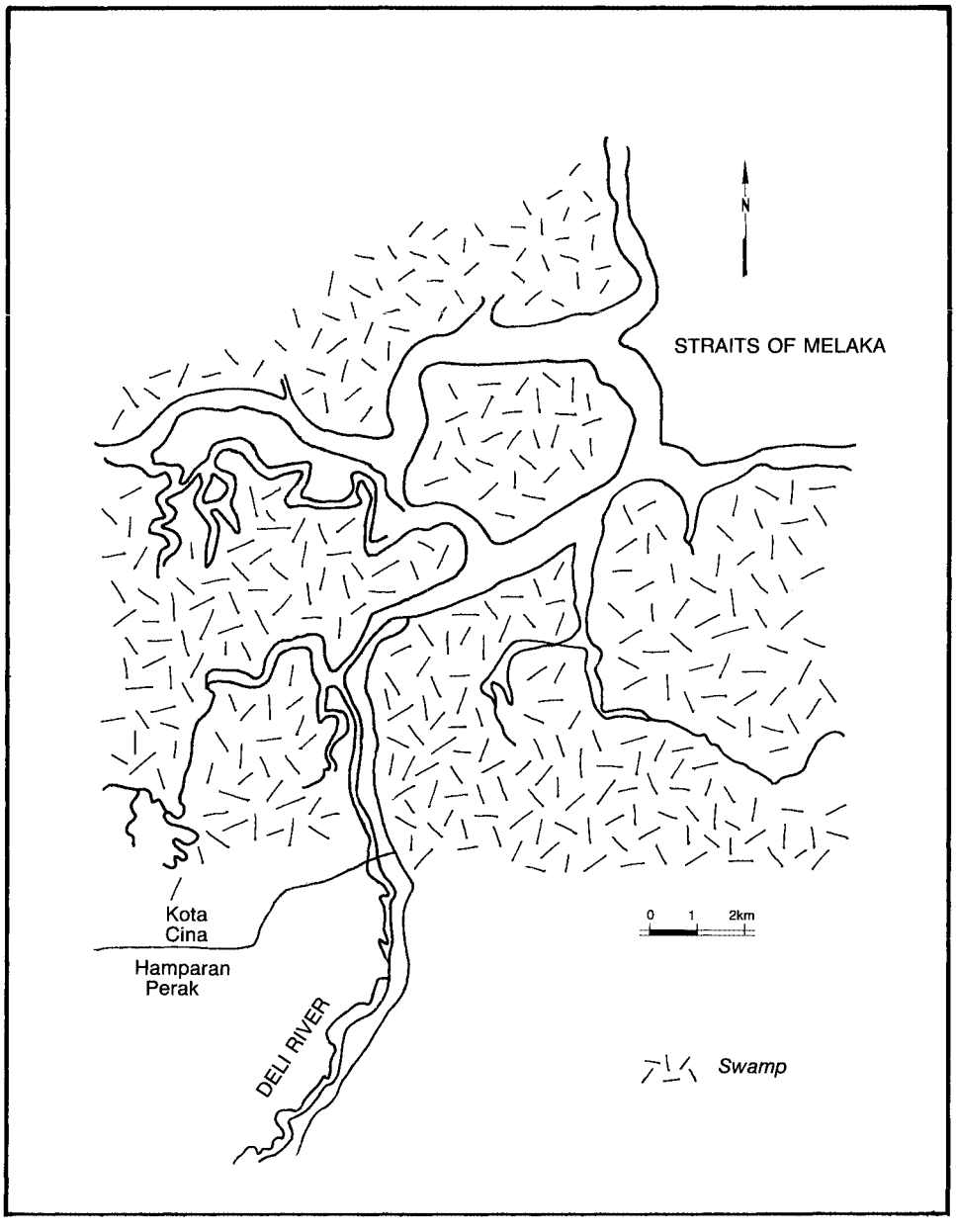

Fig. 2. Kota Cina area, northeast Sumatra.

Background Data on Kota Cina

Kota Cina now lies in a small village about 5 km inland from the Straits of Melaka (see Figure 2). Although the name means "fortified Chinese settlement," when the site was first described in 1823, no Chinese lived there. A stone inscription was reported, but it has not been seen since (Anderson 1971).

Excavations at the site have yielded large quantities of Chinese porcelain, stoneware, and coins, along with glass of undetermined origin, various metallic objects, and earthenware (most probably of local manufacture), all in a dense conglomeration of mollusk shells and other food remains. Post molds and even a few pieces of preserved wood indicated the location of pile houses. Religious architecture and sculpture have also been discovered. The complete area of the site has not been determined, but it may cover as many as 25 ha (Sonny Chr. Wibisono 1981:3).

In the early twentieth century, the area directly north and east of the site was brackish swamp that extended to the sea. In the 1970s rice fields were laid out along the north fringe of the site, but swamp still covers most of the surrounding land. To the west of the site, sand-mining operations in the last few years have turned up evidence of several shipwrecks in the area called Hamparan Perak. These include sherds of pottery of the same period as Kota Cina, associated with fragments of wood planking and fibers, probably from ropes. These finds are indications of port-related activity in that area.

Kota Cina was probably a site of urban dimensions where a cosmopolitan population resided. Chinese began to emigrate to Southeast Asia during the twelfth century A.D., perhaps around the time Kota Cina was founded. The religious artifacts discovered include stone Buddha images and a Siva lingga (phallus), all of a variety of granite not found in north Sumatra. Possible sources include the region at the south end of the Straits of Melaka, such as Bangka, on one side, and Sri Lanka or southern India on the other. The statuary displays great stylistic similarity to Buddhist images made in the south India region during this period, and it is quite likely that the statues were imported from there. Without historical data no firm conclusions can be drawn, but it is reasonable to conclude that Chinese and Indians, and perhaps Sinhalese, were visitors or residents at Kota Cina during the twelfth and thirteenth centuries. The majority of the population, however, probably came from the north Sumatran region, peoples who later became known as Batak and Malay.

The Earthenware Ceramic Assemblage

More than a ton of pottery has been recovered from archaeological excavations at Kota Cina. Earthenware constitutes approximately 65 percent of this total. The great majority of the earthenware (90 percent by weight) falls into two categories considered to be of probable local manufacture. These are distinguished primarily by the material used for temper: sand in one type (which makes up about two-thirds of the local ware), and shell in the remaining third (Miksic 1979; Edwards McKinnon 1984).

The sand-tempered ware can be divided into varieties on the basis of surface treatment and manufacturing technique (see Figures 3–6). The well-levigated paste is composed of a fine clay with numerous flecks of mica and lesser amounts of pyrite. The paste has been tempered with sand that varies from uniformly fine in some vessels to a mixture of fine and coarse particles in others. Body sherds often have a dark gray core.

Sand-Tempered, Red-Slipped Variety

Vessel forms assigned to this class (Fig. 3) are mainly cooking pots with flanged rims and carinated bodies, and constricted jars, probably storage vessels. Bases are

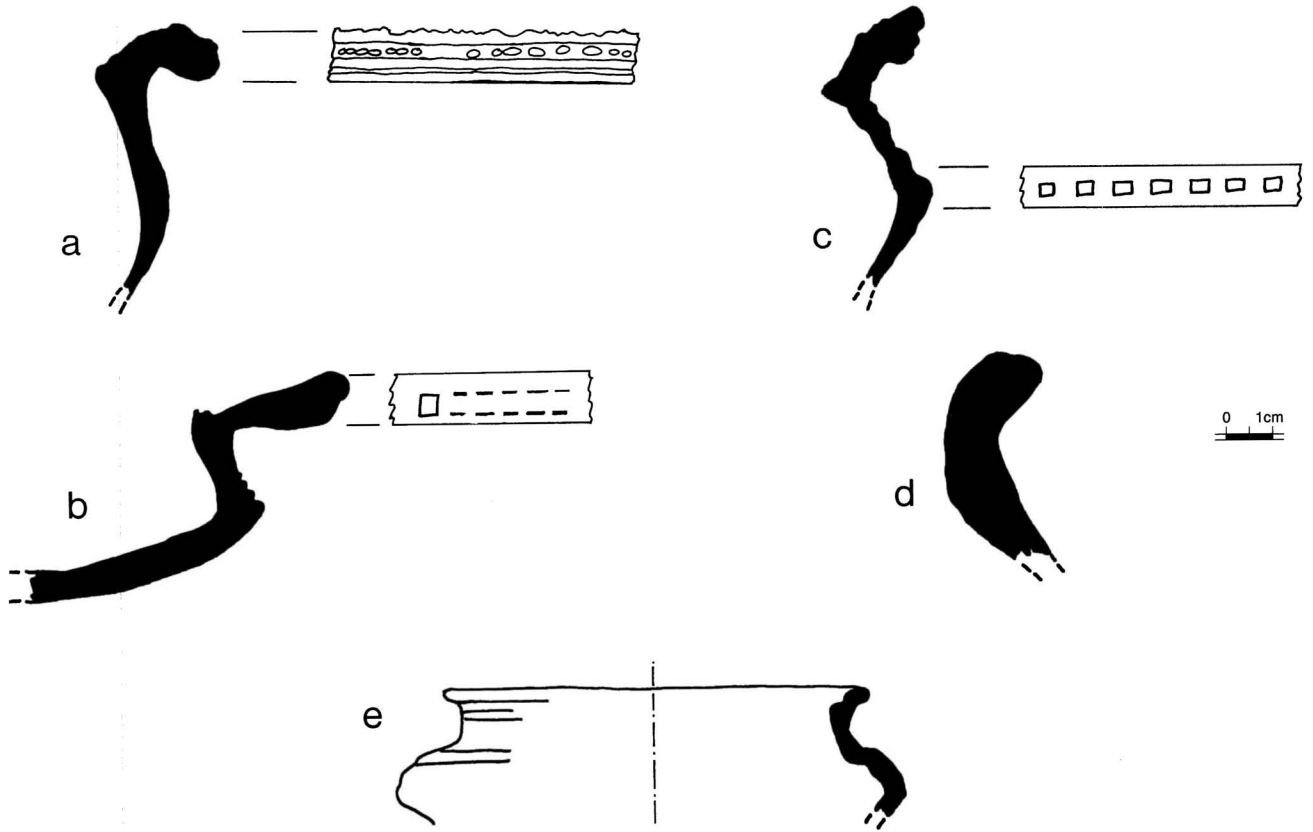

Fig. 3. Sherds of Kota Cina sand-tempered ware, red-slipped variety, representing the most common forms. *a*, rim of steep-sided vessel with incised and stamped decoration on exterior of flange; probably a cooking vessel. *b*, rim of shallow round-bottomed vessel with stamped decoration on exterior edge of flange. *c*, flanged rim of vessel; elaborate ridge indicates a cooking vessel. *d*, rim of a storage jar. *e*, profile of relatively well-preserved, small cooking pot, more finely made than the majority of this type of ware.

rounded. The wares were probably made with the paddle-and-anvil technique. Many vessels were decorated with a red slip, mainly in the 2.5 YR range of color. Exteriors of numerous sherds have black smudges and surfaces showing effects of exposure to cooking fires.

The cooking pots were otherwise undecorated, except for concentric rings incised above the carination on the exterior body and on the top and outer lips of the rims. The outer edges of about 10 percent of the rims are scalloped (Fig. 3*a–c*). Diameters ranged from 25 to 49 cm, with a mode at about 40 cm. Vessel heights ranged from 8 to 10 cm.

The storage vessels had mouth diameters of about 12 cm on average; no heights can be estimated. Rims of the vessels are usually simple and flared, though some are rolled (Fig. 3*d*, *e*).

Sand-Tempered, White-Slipped Variety

The vessels in this class (Fig. 4) are tempered with fine, well-sorted sand. The coarse particles sometimes found in the red-slipped vessels are largely absent. Two forms occur: wide-mouthed storage vessels up to 20 cm in mouth diameter, and squat pots (Fig. 4*a*, *b*).

Sand-Tempered, Unslipped Variety

This variety (Figs. 5, 6) includes cooking and storage vessels, and also a large number of spouted objects, both small pots with wide mouths, and water containers (*kendi*). There were also small pots with a particular type of incised decoration, consisting of parallel impressions made with an instrument such as a piece of bamboo (Fig. 5*c*). The rims are sometimes burnished. Two sherds have decoration consisting of vertical ridges. In one case the ridges were extruded from the body (Fig. 5*a*); in the other they were applied and have mostly fallen off (Fig. 5*b*). A few sherds possess traces of red painted design.

A large proportion of unslipped vessels were globular pots, with mouth diameters of 15–20 cm (Fig. 6*c*, *d*). Most of these were decorated with paddle impressions. The patterns at Kota Cina are very similar to those found at Pengkalan Bujang, Kedah, another trading port that was active during the same period. The patterns from Singapore are similar too, but they differ from those at the nearby site of Johor Lama, which was probably established in the early sixteenth century, after the fall of Melaka.

Shell-Tempered Pottery

This type of pottery (Fig. 7) has no subdivisions corresponding to varieties. No slip or paint was used to decorate the surfaces of objects; the only technique used was carved-paddle impression. The paste is a very pale white mixed with much coarse sand, laterite, and ground potsherds. The platy appearance of the sherd profile indicates that ground shell was also used as temper. Flecks of mica and pyrite are common. Body sherds do not exceed 4 mm in thickness, surprisingly fine considering the coarseness of the material. Nearly all vessels were round-bottomed jars; many had carinated bodies. Some lids also occur. This ware was used to make stoves and an incense burner, in addition to the vessels.

A number of other types of pottery could be described, but each is represented by very few sherds. They are probably imports, but since they were found in such low frequencies, it would serve no purpose to try to trace their origins at this time.

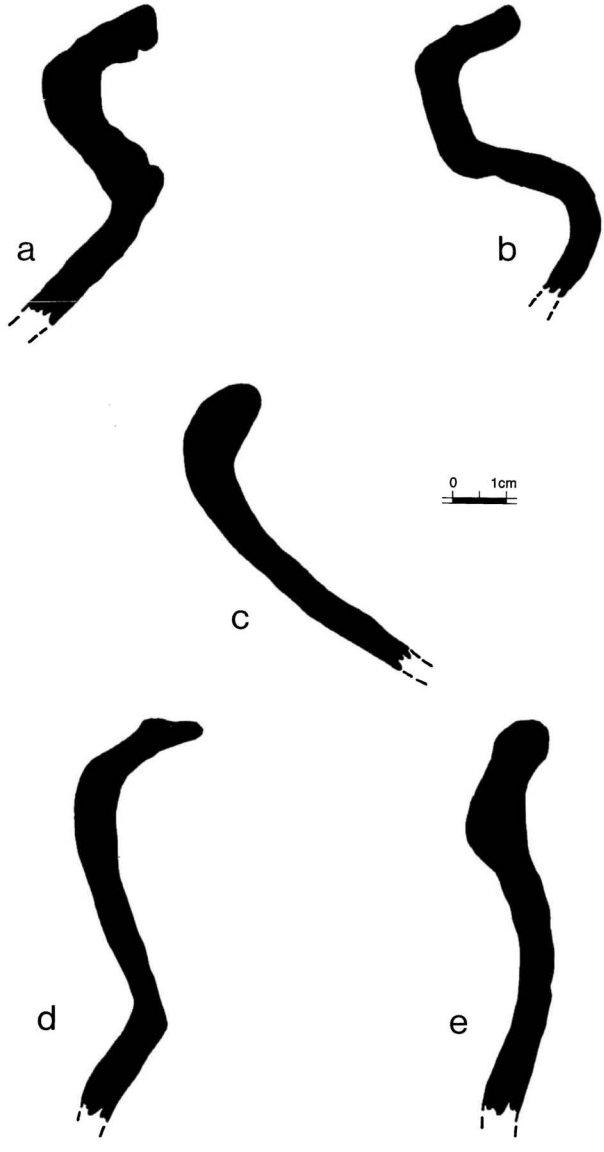

Fig. 4. Sherds of Kota Cina sand-tempered ware, white-slipped variety. *a*, rim of a carinated vessel, perhaps a cooking pot. *b*, rim of a short vessel, probably used for storage. *c–e*, rims of wide-mouthed storage vessels.

Fine Paste Ware

This ware (Fig. 8, 9) contains no discernible temper. Surfaces are usually chalk white to light buff; surface decoration includes stripes of paint, almost always red but sometimes brown or black. Incising is present, but rare. Forms include covers or lids; bowls, some with high pedestal feet; and many *kendi*. Necks and feet are often ornately decorated with many flanges.

In the assemblage of Kota Cina pottery available for study in 1976, sherds of Fine

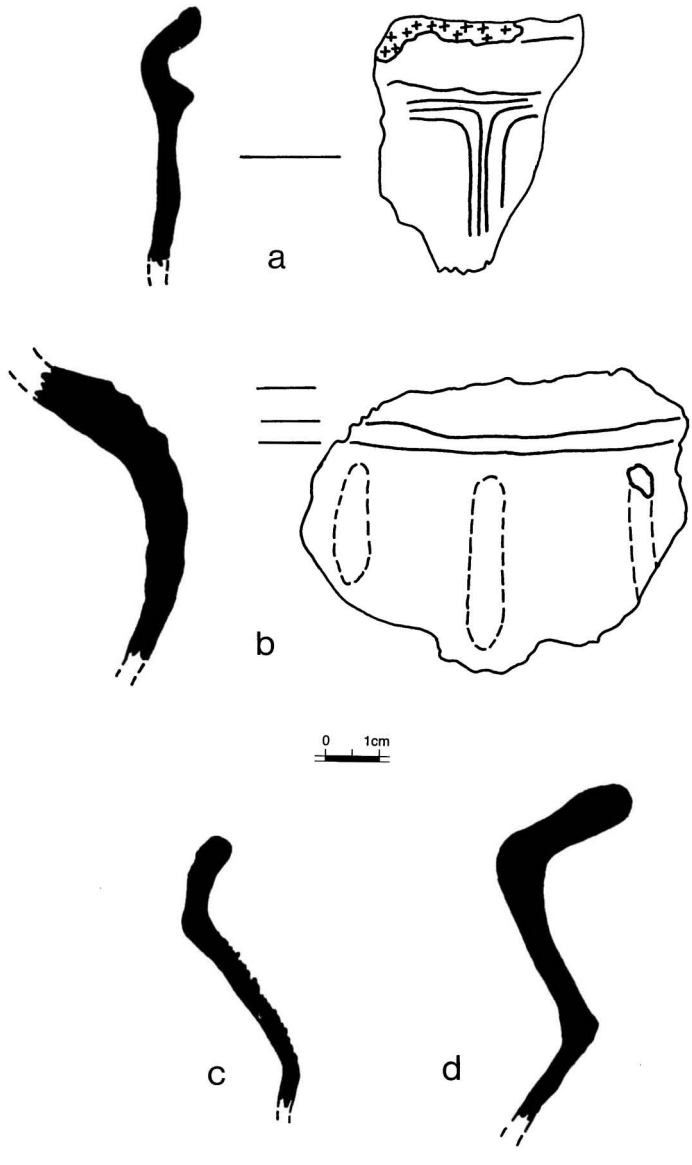

Fig. 5. Sherds of Kota Cina sand-tempered ware, unslipped variety. *a*, rim of a finely-made vessel with vertical sides and simple molded decoration in the form of flanges. *b*, body sherd of a vessel with traces of applied design in the form of simple vertical strips of clay and irregular incised horizontal lines. *c*, rim of a finely made storage vessel. *d*, rim of a carinated wide-mouth storage vessel.

Paste ware made up 8 percent of the total earthenware. In excavations conducted in 1979, Fine Paste ware constituted 4.82 percent of all earthenware by sherd count (177 out of 3678) (Sonny Chr. Wibisono 1981:12 table 17). In 1976 a small proportion of the Fine Paste ware was provisionally placed in a separate "brittle" variety on the basis of similarity in paste and shapes, but there were differences in color and

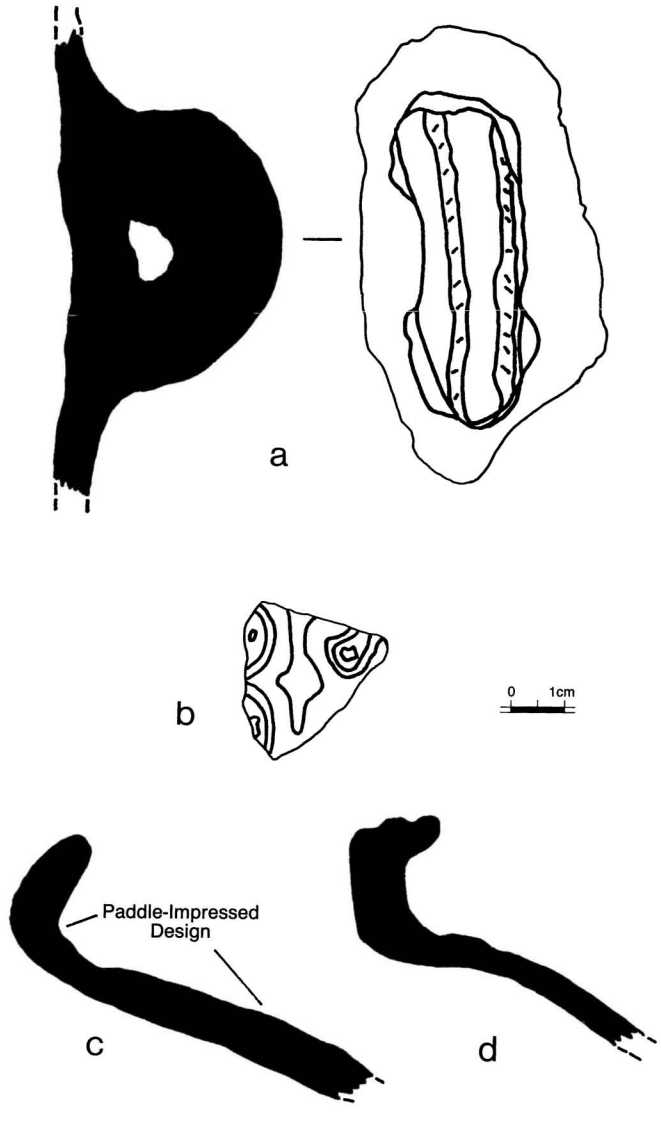

Fig. 6. Kota Cina shell-tempered ware. *a*, large loop handle with simple incised decoration parallel to the edges. *b*, body sherd with complex paddle-marked design. *c*, rim sherd of paddle-marked storage vessel showing location of decoration on such artifacts. *d*, rim sherd lacking decoration.

hardness. It was suspected that these differences resulted from irregularities in firing temperature and atmosphere.

No clay suitable for making such pottery is found in north Sumatra. The material came from sources where clay could be found in a relatively pure state, free from the sand particles and iron that occur as natural inclusions in most Southeast Asian clay deposits. According to van Bemmelen (1949, 2:196–197), deposits of kaolin are found in only a few places in Sumatra, and these are normally associated with tin-

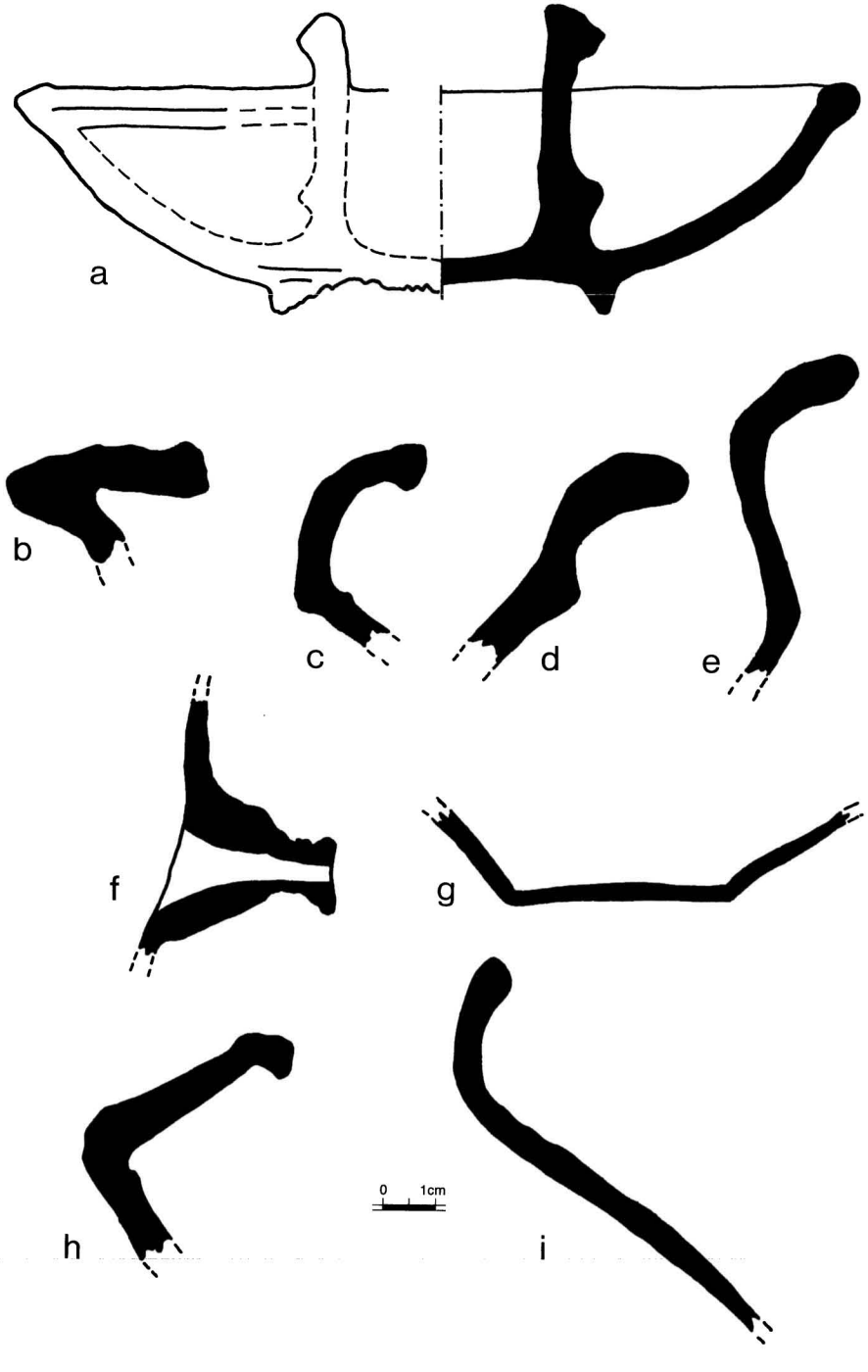

Fig. 7. Kota Cina ware. *a*, shell-tempered piece with a cup-shaped portion in the center, used as an incense burner; the upper surface between the rim and walls of the central cup is thickly coated with traces of burnt resinous material. *b–e*, common variations among rim sherds of shell-tempered ware. *f*, spout of sand-tempered piece. *g*, rare flat base of shell-tempered piece. *h–i*, rim sherds of shell-tempered ware.

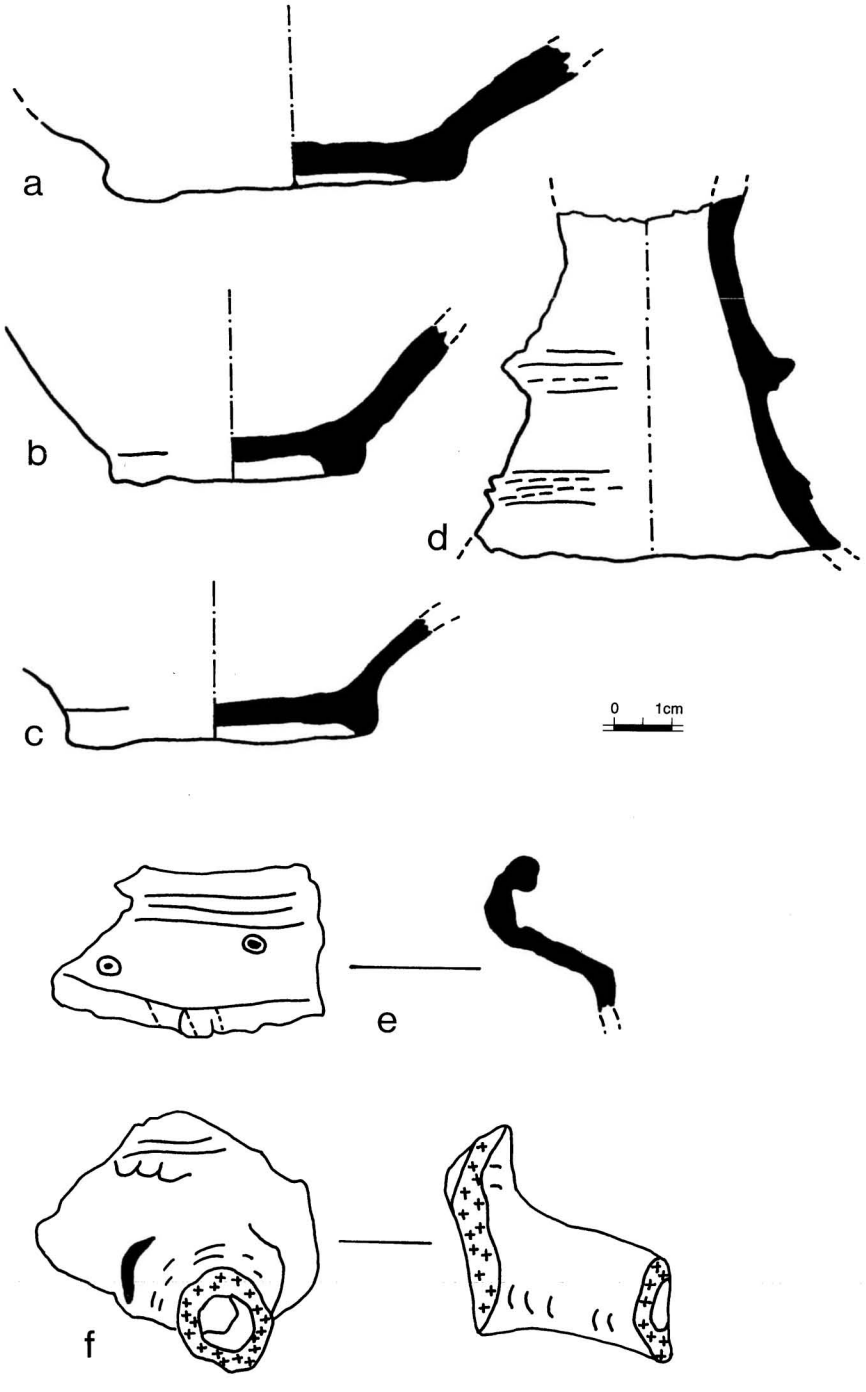

Fig. 8. Fine Paste ware sherds. *a–c*, three of the most common forms of bases with foot-rings. *d*, flanged object, probably part of a support for a pedestal bowl. *e*, rim sherd of a small container decorated with incised lines and stamped circles. *f*, spout of a *kendi* or water vessel with traces of incised decoration on the body above the spout attachment.

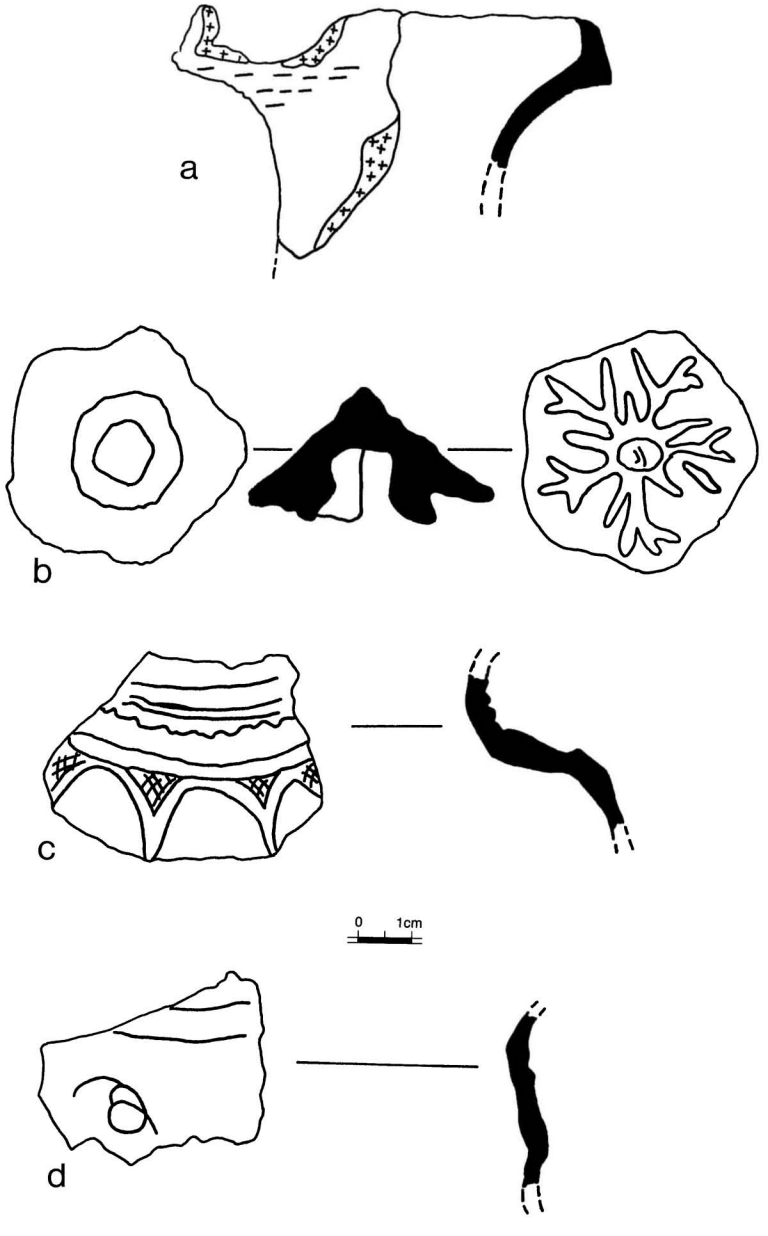

Fig. 9. Fine Paste ware sherds. *a* neck and mouth of a vessel, probably a *kendi*. *b*, cover, probably for a *kendi*, with abstract molded decoration on the upper surface. *c*, body sherd f a small container with incised decoration. *d*, body sherd of a small container with incised decoration.

bearing deposits. The nearest such deposit to Kota Cina is in the Tapanuli area, several hundred kilometers away on the other side of the Barisan Range. Geologists conducting petroleum exploration surveys for the Mobil Oil Company (James McLeod, personal communication 1976) confirmed that they had not encountered such clays during their research in northeast Sumatra or Aceh.

Thus it seemed likely that this ware represented an import commodity. The origin of the ware could not be traced with the data then available. The first round of x-ray fluorescence tests indicated that at least two possible centers of production existed: one in south Thailand, another in east Java. Kota Cina lies very near the Satingphra/Kok Moh area of south Thailand, so it seemed likely that the Fine Paste ware came from there rather than from Java.

To test the hypothesis that the Kota Cina Fine Paste ware originated from south Thailand, we analyzed 37 sherds, including 5 of the "brittle" variety. To investigate a possible alternative source, we also tested two sherds of modern pottery made in Palembang that had very similar characteristics. We then compared these samples with the results of the earlier study.

X-Ray Fluorescence Spectrometry

The energy dispersive x-ray fluorescence (EDXRF) technique has proved to be an extremely useful nondestructive method for the study of Chinese porcelains (Yap 1984, 1986*a*, 1986*b*, 1987*a*, 1987*b*, 1987*c*, 1987*d*, 1988, 1989), Japanese pottery (Yap and Vijiyakumar 1990), and Southeast Asian earthenware (Miksic and Yap 1989–1990). For this study, we employed the EDXRF technique together with principal component analysis, which is a powerful technique for the multivariate analysis of data.

The concentrations of the following 12 elements were measured: manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). The samples we studied included Kota Cina sherds (KC1–KC30 and KC63–KC68); earthenware samples from south Thailand, Singapore, and Java (NM15–NM40; see Miksic and Yap [1989–1990]); and Palembang sherds (PG1 and PG2).

Principal Component Analysis

The objective of principal component analysis is to take multiple variables (in this case the concentrations of the 12 trace elements identified above) and find linear combinations to produce new variables, known as principal components, that are uncorrelated, with principal component 1 having the largest variance, principal component 2 the second largest variance, and so on. Therefore, if the data are highly correlated, positively or negatively, we can reduce the number of dimensions drastically from 12 to as few as 2 or 3 depending on the data. In general, there is a good deal of redundancy among most compositional variables, because they are measuring similar things—in this case a few clay sources.

The concentrations of the 12 elements measured on 64 samples (KC1–KC30, KC63–KC68, NM15–NM40, PG1–PG1) form a data matrix $X_{(N \times N)}$ where x_{nm} is the value of the concentration of element m measured on sample n. The mean $\bar{x}_m$ and standard deviation s_m of the concentration of each element are given by:

$$\bar{x}_m = \frac{1}{N} \sum_{n=1}^{N} x_{nm}$$

$$s_m^2 = \frac{1}{N-1} \sum_{n=1}^{N} (x_{nm} - \bar{x}_m)^2$$

To avoid the concentration of any element having too much influence on the principal components, the data are autoscaled to have a mean of zero and variance of one:

$$z_{nm} = \frac{x_{nm} - \bar{x}_m}{s_m}$$

The principal components P are calculated (Cooley and Lohnes 1971) as linear combinations of the original variables (concentrations of elements), such that the first principle component has the largest variance, the second principal component has the second largest variance and is orthogonal to the first, and so on. This is expressed as

$$p_{nk} = \sum_{m=1}^{M} z_{nm}\, v_{mk}$$

where p_{nk} is the value of the k^{th} principal component for sample n, and v_{mk} the m^{th} term of the k^{th} eigenvector of the $(M \times M)$ correlation matrix. All calculations were done with the SAS (Statistical Analysis System) program on an IBM mainframe 3081.

RESULTS AND DISCUSSION

Figure 10 shows a plot of principal components 1 and 2 using the concentrations of all the 12 elements measured on the 64 samples. Various groups can be visualized. Three groups have previously been identified (Miksic and Yap 1989–1990); they are NMA (east Java), NMB (Dieng Plateau, central Java) and NMC (south Thailand). These groups were identified using a triangular plot or ternary diagram in which the relative concentrations of Rb, Sr, and Zr were normalized such that

$$C_{Rb} + C_{Sr} + C_{Cr} = 100\%$$

However, Yap and Vijiyakumar (1990) have pointed out that such ternary diagrams are inferior to plots from principal component analysis because points on ternary diagrams do not correspond to points in an actual three-dimensional diagram. For example, two samples with different absolute concentrations but in appropriate ratios may still occupy the same position in a ternary diagram. In Figure 10, the same samples are segregated into groups NMA, NMB, and NMC, with the exception that one sample in NMB has now been reclassified into NMA. The 36 pieces from Kota Cina were of two types: KC1–KC30 are the regular type, while KC63–KC68 are the brittle variety. In the figure, they are grouped as KCA and KCB respectively, with two pieces (KC1 and KC68) scattered far away and one piece (KC5) in the NMC (south Thailand) group. The two modern pieces from Palembang form a group by themselves. The results of the present analysis show that the plot of principal components 1 and 2 is not quite satisfactory, as the cumulative variance for these two principal components amounts to only 45 percent of the total variance. Moreover, from the table of correlations in the results of the analysis and from the small contributions of certain elements to the eigenvectors, the following elements can be removed: Fe, Co, Ni, Cu, and Zn.

Principal component analysis was then performed on the concentrations of the remaining seven elements: Mn, Ga, Rb, Sr, Y, Zr, and Nb. This procedure yields a

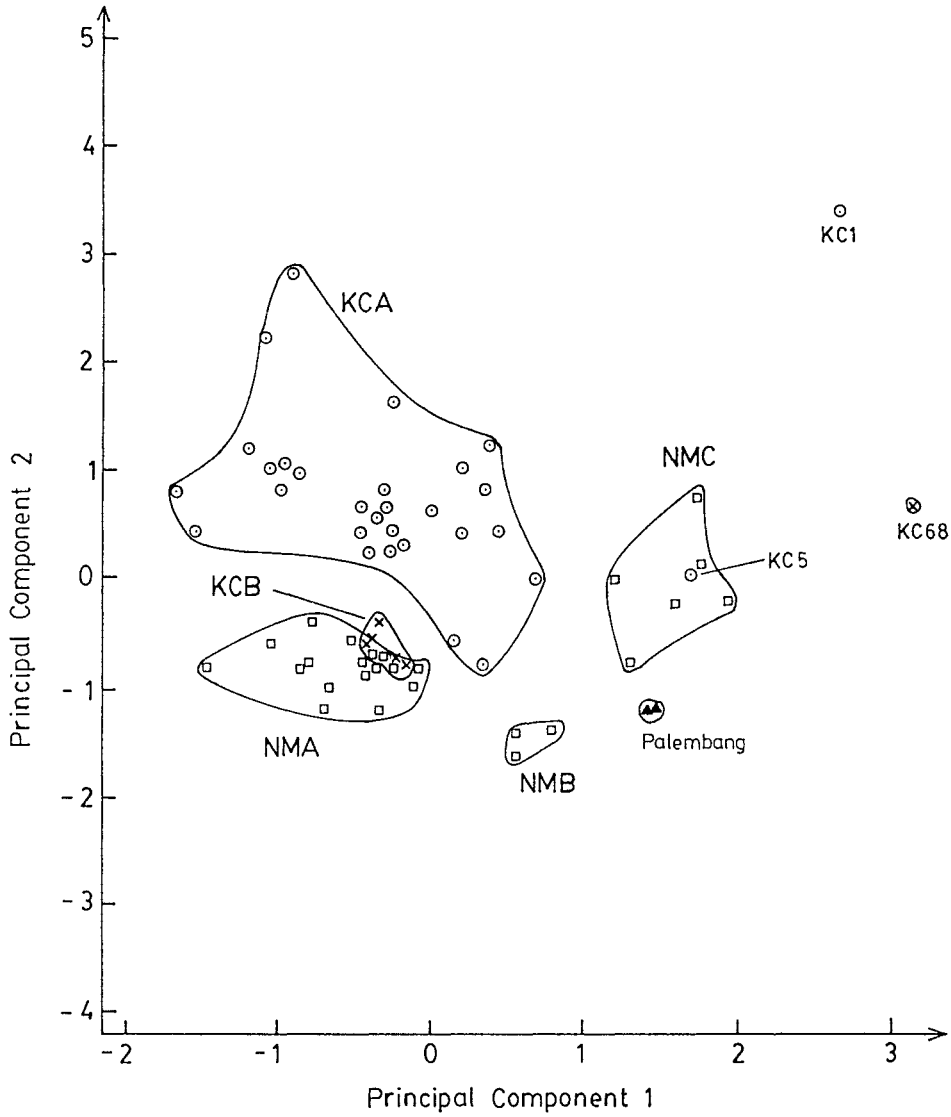

Fig. 10. Plot of pottery samples from Southeast Asia for the first two principal components, using the concentrations of 12 elements (Mn, Fe, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, Nb).

cumulative variance for these two principal components of 64 percent of the total variance. The group NMB is now relatively farther from both groups NMA and NMC. The KCA group is now more compressed, and the KCB group is completely within the NMA group. The table of correlations indicates that Ga could be removed.

With the removal of Ga, principal components 1 and 2 yield cumulative variance of 70 percent of the total variance. The overlap between the KCA and KCB groups

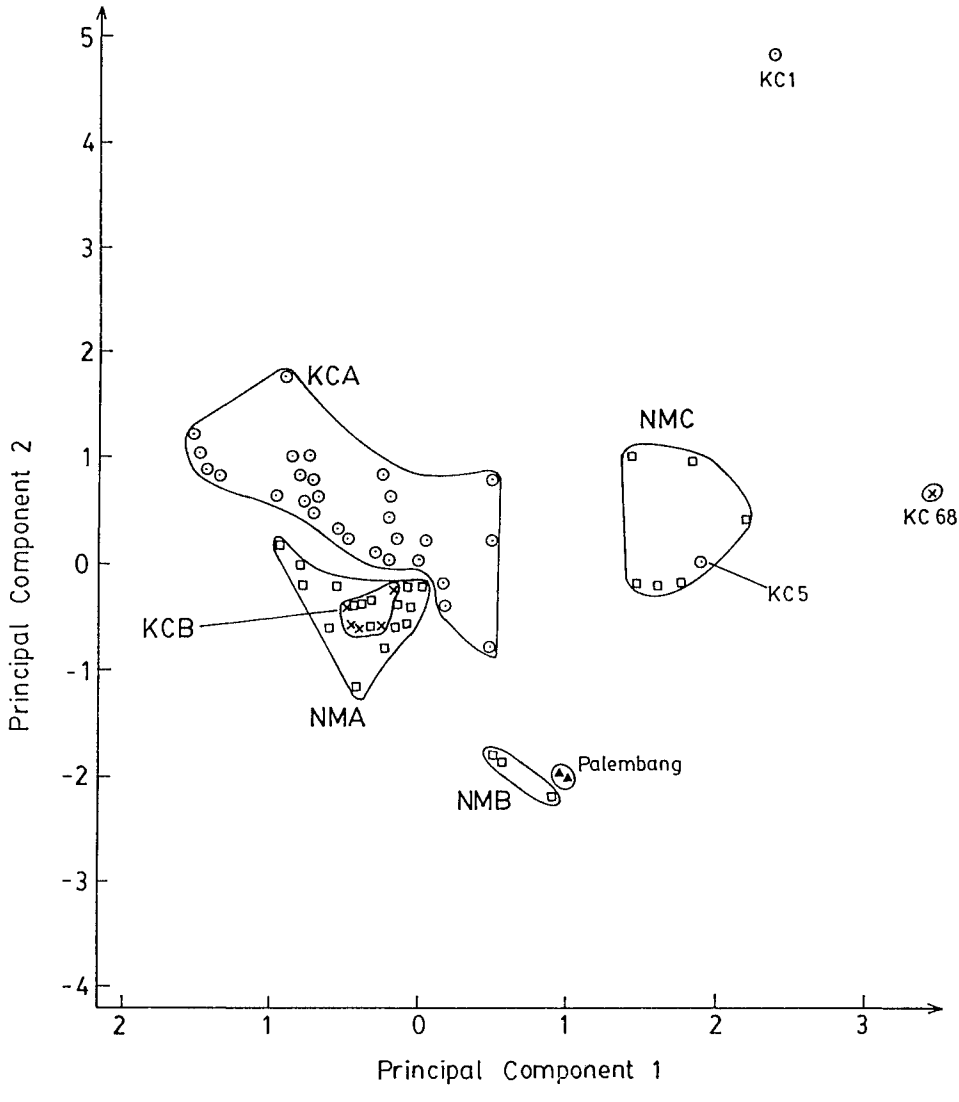

Fig. 11. Plot of pottery samples from Southeast Asia for the first two principal components, using the concentrations of five elements (Rb, Sr, Y, Zr, Nb).

is marginal. The correlations are generally good, except that the correlations of Mn with Rb and Nb are on the weak side, with respective correlation coefficients of 0.12 and −0.21. The contributions of the various elements to the eigenvectors of principal components 1 and 2 are generally good.

If we proceed further and remove Mn, the principal component analysis yields the result shown in Figure 11 for the principal components 1 and 2, with a cumulative variance of nearly 80 percent of the total variance. In this case, the correlations among the various elements are quite good. The same remarks apply to the con-

tributions of the various elements to the eigenvectors of these two principal components. Although group segregation is roughly the same, the Palembang group has now merged into the NMB group.

Although no drastic change is observed when the number of elements is reduced from 12 to 5, we still believe that Figure 11 more realistically represents the actual groupings. In such a situation, we are not dealing with either major or minor elements but with trace elements with concentration levels from about 10 ppm to a few hundred ppm (1 percent = 10,000 ppm). Previous studies have shown that such trace elements—particularly Rb, Sr, Y, Zr, and Nb—are useful in locating the geographical origin of porcelain and earthenware samples.

HISTORICAL IMPLICATIONS

The initial hypothesis—that the Kota Cina Fine Paste ware came from south Thailand—is almost certainly incorrect. Only 1 sherd out of 37 from Kota Cina falls into the NMC (south Thailand) group. Two other sherds (KC 1, KC 68) fall far outside the range of any known group. The other 34 sherds cluster in the same area of the graph as the sherds from east Java (NMA).

Within the Kota Cina sherd group, there are two distinct subgroups. The five sherds in the KCB set are all of the so-called "brittle variety." It now seems that their composition is slightly different from that of the rest of the Kota Cina sherds. The KCB sherds all fall within the range of variation of the east Java ware. The majority of the Kota Cina sherds (KCA) form a rather loose group that lies beside the east Java sherds. It is therefore highly probable that they come from east Java.

This result suggests that there may have been more than one center of production of fine ceremonial ceramics for export in east Java during the twelfth to thirteenth centuries A.D. This would account for the relatively wide dispersal of the sherds in this group. The new statistical technique appears to constitute a definite improvement over the previous one; it removes one sherd from the NMB group, where it seems out of place, and into the NMA group. This is a sherd of fine ware that contrasted visually with the coarse, tempered ware of the other three sherds.

Finally, why did the populations of north Sumatra bother to import this ware from such a great distance when another source of similar pottery lay so close by, in south Thailand? No firm explanation is possible, but the most likely reason is that Kota Cina had much more important trading links with east Java than with south Thailand. In addition, coastal groups in Sumatra may have been competitors with the peninsular ports of south Thailand. Both groups would have vied to provision ships traveling from the Indian Ocean and South China Sea whose routes intersected in the Straits of Melaka. Both India and China traded for the Moluccan spices; east Java probably controlled their transport as far as the Straits. Thus, the Fine Paste ware would have been carried from east Java to Kota Cina along with cloves and nutmeg.

It is difficult to determine how important an economic role the trade in local pottery played in early Southeast Asia. The proportion of Fine Paste ware in the Kota Cina assemblage is not inconsiderable, however. The data from this study reinforce the view that further research into the geographical distribution and frequency of this pottery has the potential to clarify the trading relations within Southeast Asia in the period between the tenth and fourteenth centuries.

ACKNOWLEDGMENTS

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ABSTRACT

Previous research on the mineral composition of Southeast Asian earthenware pottery suggested that different production locales might be discriminated on the basis of trace elements. Additional tests have now been conducted on a large number of samples. The results confirm those of the earlier research and provide additional evidence on trade in locally made pottery in Southeast Asia during the ninth to fourteenth centuries A.D. We can now state that a particular form of Fine Paste ware was shipped from east Java to north Sumatra during this period. In addition, with this larger sample it was possible to statistically define the divisions between various classes of pottery from north Sumatra.
KEYWORDS: Ceramic compositional analysis, Southeast Asian prehistory, prehistoric pottery production and trade.